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(54) System for recording and/or reading an information signal, record carrier and recording and/or read apparatus for use in such a system, and method of and apparatus for manufacturing such a record carrier.

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Description

The invention relates to a system for recording and/or reading an information signal, which system comprises an optically readable record carrier provided with a track containing an information area in which he information signal is recorded or can be recorded, in which track a position-information signal which is synchronous with a clock signal is recorded by means of a track modulation corresponding to the position-information signal, and an apparatus for recording and/or reading the information signal, which apparatus comprises an optical system for scanning the information area with a radiation beam, an optical detector for detecting the radiation beam reflected by the information area and for generating a detection signal which is representative of the modulation of the radiation beam caused by the track modulation, a detection circuit for extracting the position-information signal from the detection signal and a clock-regeneration circuit for recovering the clock signal.

The invention also relates to a record carrier and a recording and/or read apparatus for use in the system.

The invention further relates to a method and apparatus for manufacturing a record carrier for use in the system. A system as defined in the opening paragraph is described in the Patent Application GB 2,069,219.

The system described therein utilizes a record carrier in the form of an optically readable disc provided with a track formed by a spiral groove. The track comprises information areas which alternate with synchronization areas. The information areas are intended for recording information, whilst the synchronization areas provide control information for controlling the recording process by means of a preformed track modulation. This control information comprises inter alia position information in the form of an address of an information area adjoining the synchronization area. If by means of the recording and/or read apparatus information is to be recorded in an information area having a specific address, the addresses of the synchronization areas are read by scanning the synchronization areas with the radiation beam. The information area where the information is to be recorded is located with the aid of the addresses thus read.

Although a specific track portion in which the information signal is to be recorded can be located by means of this known system the known system has the draw-back that the information areas are each time interrupted by the synchronization areas.

This is a disadvantage, particularly if EFM-modulated information is to be recorded. For this recording method an uninterrupted information area is desirable.

It is an object of the invention to provide means which enable recordings to be made in uninterrupted information areas and which during scanning of the record carrier enable the location of the part of the record carrier being scanned to be derived from the radiation beam reflected from the record carrier, and which enable the control of the scanning velocity.

In accordance with the invention a system as defined in the opening paragraph is therefor characterized in that the track modulation corresponding to the position-information signal is situated at the location of the information area as a continuous track modulation in such way that the frequency spectrum of the position-information signal is situated substantially outside the frequency range occupied by the frequency spectrum of the information signal, and such that the frequency of the clock signal of the position-information signal is substantially constant when the track is scanned with a constant linear velocity, the apparatus further comprises a control circuit for controlling on the basis of the clock signal the scanning velocity at a value for which the frequency of the clock signal is equal to a reference frequency, the frequency spectrum of the position-information signal being situated substantially outside the frequency band employed for velocity control.

EP-A-0.265.695, which is a prior right under ART 54(3)(4) EPC, also discloses a system in which an EFM-signal is recorded in an uninterrupted part of a servo track provided with a track modulation representing position information.

However EP-A-0.265.695 does not disclose the control of the scanning velocity on the basis of the track modulation.

An embodiment of the system, which is characterized in that the detection circuit for extracting the position-information signal from the detection signal, comprises a filter having a pass band which substantially corresponds to the frequency band occupied by the frequency spectrum of the position-information signal, enables the position information signal to be derived from the detection signal very simply.

A type of modulation which is very suitable for the position-information signal and for which the frequency spectrum of the information signal exhibits substantially no frequency components in the low-frequency band utilized for velocity control is "biphase" modulation or "biphase-mark" modulation.

For recording the information signal various types of track modulations may be used. If, as is customary, the information to be recorded in the information areas is recorded in the form of recording marks having a reflectivity which differs from the surrounding area, a track modulation in the

form of a track undulation whose excursion relative to the track corresponds to the signal value of the position-information signal is very suitable. This yields a very satisfactory signal separation between the two information signals.

Embodiments of the invention and further advantages thereof will now be described in more detail, by way of example, with reference to Figures 1 to 11, of which

Figure 1 shows an embodiment of the record carrier in accordance with the invention

Figure 2 shows an example of a position-information code;

Figure 3 shows an example of the track modulation corresponding to the position-information signal;

Figure 4 shows a recording and/or read apparatus in accordance with the invention;

Figure 5 shows some signals occurring in the recording and/or read apparatus of Figure 4 as a function of time;

Figure 6 shows the frequency spectra of the information signal and the position-information signal, and the frequency band used for scanning-velocity control;

Figure 7 shows an example of the detector used in the recording and/or read apparatus of Figure 4;

Figure 8 shows an apparatus for manufacturing the record carrier in accordance with the invention;

Figure 9 shows an example of the position-information signal; and

Figure 10 and 11 show another embodiment of the record carrier in accordance with the invention.

Figure 1 shows possible embodiments of a record carrier 1 for use in the system in accordance with the invention, Figure 1a being a plan view, Figure 1b showing a small part of a sectional view taken on the line b-b, and Figure 1c and Figure 1d being highly enlarged plan views of a part 2 of a first and a second embodiment of the record carrier 1. The information carrier 1 is provided with an information area constituted by a track 4 in the form of a preformed groove. The track 4 is intended for recording an information signal Vi. For the purpose of recording the record carrier 1 is provided with a recording layer 6 which is deposited on a substrate 5 and which is covered with a radiation-transmitting protective coating 7. The recording layer 6 is of a material which, when exposed to suitable radiation, is subjected to an optically detectable change. Such a layer may comprise, for example, a thin metal layer such as tellurium. By means of laser radiation of sufficiently high intensity this metal layer can be melted locally, as a result of which this layer is locally given another reflection coefficient, so that when an information area thus formed is scanned by a radiation beam the reflected beam is amplitude-modulated in conformity with the recorded information. Alternatively, the layer 6 may consist of the radiation-sensitive materials as described, for example, in the book "Principles of Optical Disc Systems", Adam Hilgar Ltd., Bristol and Boston, pages 210-227.

The groove comprising the track 4 may be employed as a servo track, enabling a radiation beam projected on the record carrier to record the information to be accurately incident on the information area 4 constituted by the groove, i.e. enabling the position of the radiation beam in a radial direction to be controlled via a tracking system utilizing the light reflected from the record carrier 1. The measurement system for measuring the radial position of the radiation spot on the record carrier may correspond to one of the systems as described in the aforementioned book "Principles of Optical Disc Systems.

For determining the position of the radiation spot within the information area a position-information signal V_p is recorded in the information area 4 by means of a preformed track modulation, for example a track undulation as is shown in Figure 1c. However, other track modulations such as for example track-width modulation (Figure 1d) are also suited for this purpose. The position information represented by the position-information signal V_p may comprise a binary position-information code (PIC), for example in the form of a time code which indicates the time needed to cover the distance from the beginning of the track to the position where the position-information signal is located during scanning with the nominal scanning velocity. Such a time code may comprise, for example, a plurality of consecutive bits, as for example used in recording EFM-modulated information on CD and CD-ROM discs. Figure 2 shows a modification of the time code used in CD and CD-ROM, comprising a first portion 10 indicating the time in minutes, a second portion 11 indicating the time in seconds, a third portion 12 indicating a frame number, a fourth portion 12A indicating a sub-frame, and a fifth portion 13 comprising a plurality of correction bits.

Figure 3a is the plan view of a part of a track 4 which exhibits a track undulation corresponding to a "biphase" modulated position-information signal V_p. The track 4 comprises track portion 40 having a length L, each representing one bit of the position-information code (PIC). A bit of the logic value "1" is represented by a track portion 40 having a positive track excursion in a direction perpendicular to the track direction 42 over a first portion having a length 1/2 L, followed by a second portion also

having a length 1/2 L and having a negative track excursion. A bit of the position-information code (PIC) of logic value "0" is represented by an opposite track undulation pattern, i.e. it comprises a first portion of a length 1/2 L with a negative track excursion, followed by a second portion of a length 1/2 L with a positive track excursion.

The track portion 40 which indicates the first bit of a position-information code is preceded by a synchronization track portion 43 with a track undulation of a shape which can be distinguished from the shape for the track undulation at the location of the track portions 40 representing the bits of the position-information code(PIC).

The synchronization track portion 43 shown in Figure 3a comprises a first portion having a length of 1 1/2 L with a positive track excursion, followed by a second portion also having a length of 1 1/2 L with a negative track excursion. Since in the track portions 40 the length of a track portion with a positive or negative track excursion is always equal to L or 1/2L, the beginning of each position-information code (PIC) is marked unambiguously by the synchronization track portion 43.

Figure 3c is a plan view of a part of the track 4 which exhibits a track undulation corresponding to a "biphase-mark" modulated position-information signal V_p.In such a modulation the track 4 is again divided into track portions 45 of a length L, each representing one bit of the position-information code (PIC). In this modulation the excursion at the location of the boundaries between the track portions 45 always exhibits a reversal of direction.

A bit of the the logic value "0" is represented by a track portion having an excursion whose direction does not change within the entire track portion 45. A bit of the logic value "1" is represented by a track portion in which the direction of the excursion is reversed. The time-information code is again preceded by a synchronisation track portion 46 which can be distinguished from the track portions 45 and which has a length which is six times the length L of the track portions 40, the direction of the excursion being reversed halfway the synchronization-track portion. Instead of the radial track modulations shown in Figures 3a and 3c the time code can be represented similarly by the track-width modulation shown in Figure 1d.

Figure 4 shows a recording and/or read apparatus 50 for recording and reading the record carrier 1. The apparatus 50 comprises a motor 51 for rotating the record carrier 1 about an axis 52. An optical write/read head 53 of a customary type is arranged opposite the record carrier 1. The write/read heat 53 comprises a radiation source in the form of a laser 54 for generating a radiation beam 55, and an objective 56 by means of which the radiation beam 55 can be focussed to form a tiny scanning spot on the recording layer 6.

The read/write head 53 can be operated in two modes, namely: a first mode (read mode) in which the laser 54 generates a radiation beam of constant intensity which is inadequate to produce the optically detectable change in the recording layer 6, and a second mode (recording mode) in which the radiation beam 53 is modulated in conformity with an information signal to be recorded in order to form a pattern of recording marks 44 having changed optical properties in conformity with the information signal Vi in the recording layer 6 at the location of the track 4 (see Figure 3b).

The beam which is reflected by the track 4 is passed to a radiation-sensitive detector 57 of a customary type via a semi-transparent mirror 55a. The detector 57 is constructed to generate a tracking-error signal which indicates the position of the radiation spot relative to the track 4. The tracking-error signal is applied to a radial-position control circuit 58 which ensures that the radiation beam 55 remains on the track 4. Moreover, the detector 57 detects the intensity modulation caused by the track modulation in the radiation beam reflected by the record carrier 1. The detector 57 supplies a detection signal Vd corresponding to the detected intensity modulation.

The position-information code (PIC) represented by the preformed track modulation is recovered from the detection signal Vd by a detection device 59. For this purpose the detection circuit 59 comprises a band-pass filter 60 which is adjusted in such a way that when the track 4 is scanned with the nominal scanning velocity it almost exclusively transmits the position-information signal Vp (see Figure 5) corresponding to the preformed track modulation. By means of a customary phase-locked loop circuit, comprising a phase detector 61 and a voltage-controlled oscillator 62, a clock signal c1 (see Figure 5) which is in synchronism with the position-information signal Vp is derived from the position-information signal Vp.

By means of a sampling circuit 63 which is controlled by the clock signal and a comparator circuit 64 the position-information signal Vp is converted into a binary signal Vp' (see Fig. 5), from which the individual bits of the position-information codes (PIC) are recovered by means of a "biphase" demodulator 65A of a customary type.

The frequency of the clock signal cl is proportional to the velocity with which the track 4 is scanned, so that this clock signal cl can be used as a measurement signal for the purpose of controlling the scanning velocity. In the embodiment shown, this velocity control is achieved in that a phase detector 65 compares the phase of the clock signals cl with the phase of a periodic reference signal Vr of constant frequency fr which is generated by

an oscillator 66. By means of a control circuit 67 the speed of the motor 51 is controlled at a value for which the phase difference determined by the phase detector 65 remains substantially zero, so that the scanning velocity of the disk is maintained constant at a value dictated by the frequency fr. If by means of the read/write apparatus 50 an information signal Vi is to be recorded in a portion of the track 4 defined by a selected position-information code, the desired track portion can be located prior to recording by means of the position-information codes (PIC) read in the read mode. As soon as the desired track portion has been located, the read/write head 53 can be operated in the write mode, the radiation beam 55 then being modulated in conformity with the information signal Vi to be recorded.

Figure 3b, by way of example, shows a pattern of recording marks 44 with modified optical properties, arising during recording of, for example, information signal Vi which is an EFM-modulated in conformity with the CD standard. The frequency spectrum of such an EFM-modulated information signal is indicated by the reference numeral 30 in Figure 6. As is apparent from Figure 6, the EFM-modulated information signal Vi does not exhibit any strong frequency components below 100 KHz.

The track modulation representing the position-information signal Vp is dimensioned in such a way that the frequency spectrum for the position-information signal Vp read at the nominal scanning velocity does not exhibit any strong frequency components in the frequency range Be occupied by the information signal Vi. The frequency spectrum of the position-information signal Vp bears the reference numeral 31 in Figure 6. If the position-information signal is "biphase" or "biphase-mark" modulated as in the embodiments described above, the frequency spectrum of the position-information signal Vp does not exhibit any strong frequency components situated within the frequency band Br used for scanning velocity control (indicated by the reference numeral 32).

If the frequency spectra 30 and 31 do not overlap, as is indicated in Figure 6, the position-information signal Vp and the information signal Vi can always be read simultaneously without any significant interaction, so that it is also possible to read the position-information codes (PIC) during recording of the information signal or during reading of a signal already-recorded. Moreover, as the frequency spectrum 31 exhibits substantially no frequency components within the frequency band Br, scanning-velocity control is not influenced by the position-information signal Vp. If the recorded signal is an EFM modulated signal in conformity with the CD-standard, a position-information signal which is in synchronism with a 22.05kHz or 44.1-kHz clock signal is very suitable.

Since for such an EFM modulation the repetition frequency of the data words is 44.1 kHz, the recording apparatus must comprise a 44.1 kHz frequency source, so that the reference signal Vr for scanning-velocity control may be derived from this frequency source, which is available any-way. The frequency spectrum 31 in Figure 6 corresponds to the spectrum of a signal which is "biphase" modulated with a clock frequency of 44.1 kHz.

In the embodiment of the record carrier described in the foregoing the preformed track modulation corresponds to a "biphase" or a "biphase-mark" modulated position-information signal Vp. However, it will be evident that, in principle, any track modulation is suitable, which corresponds to a position-information signal Vp having a frequency spectrum which does not overlap the frequency spectrum of the information signal Vi. If a measurement signal for scanning-velocity control is derived from the position-information signal Vp, it is moreover required that the frequency spectrum of the position-information signal does not comprise any strong frequency components within the frequency band used for scanning-velocity control.

When a track modulation in the form of a track undulation is employed a very satisfactory signal separation between the information signal Vi and the position-information signal Vp during read-out can be obtained by means of the optical detector 57 shown in Figure 7. The detector 57 comprises a photodetector 70 which is divided in two parts a and b along an axial line. A differential amplifier 71 supplies a difference signal representing the difference between the amounts of radiation of the modulated beam 55 detected by the parts a and b. A summing amplifier 72 supplies a sum signal, which is representative of the sum of the amounts of radiation detected by the parts a and b.

Generally, the bandwidth of the tracking control is too small to enable the track undulation to be followed. In that case the track 4 will be scanned in such a way that the centre of the scanning beam 55 follows a path 73 which is respresentative of the average position of the centre of the track 4. The modulation of the radiation beam produced by the track undulation will be represented strongly in the signal on the output of the differential amplifier 71, whilst the modulation caused by the recorded information signal will be represented in particular in the signal on the output of the summing amplifier. A filter 74 rejects the frequency components situated outside the frequency range occupied by the information signal, so that the signal Vi on the output of the filter 74 almost exclusively comprises the frequency components of the information signal Vi.

Similarly, the filter 60 removes undesired frequency components from the position-information signal Vp. The position-information signal Vp is very suitable for locating the track portion desired for recording the information signal. However, said signal is also useful for detecting undesired track jumps, for example as a result of mechanical vibrations. A track jump can then be detected by means of the position-information codes (PIC) read consecutively. If two consecutive position-information codes (PIC) do not adjoin each other, this means that a track jump has occurred. The above method of recording position-information codes enables a very fast detection of undesired track jumps to be effected, because the number of position-information codes recorded per unit of time is very high in comparison with the number of time codes recorded per unit of time in CD or CD-ROM system.

Figure 8 shows an embodiment of an apparatus for manufacturing a record carrier in accordance with the invention. The apparatus 81 comprises a turntable 82 which can be rotated by a drive means 83. A disc-shaped carrier 84, for example a flat glass disc provided with a light-sensitive layer 85, for example in the form of a photoresist, can be placed on the turntable 82.

A laser 86 generates a light beam 87 which is projected onto the light-sensitive layer 85. The light beam 87 is first passed through a deflection device 90. The deflection device 90 is of a type by means of which a light beam can be deflected vary accurately within a small range. The deflection device may be, for example, a mirror which can be pivoted through a small angle, an electro-optical deflection device or an acousto-optical deflection device. In Figure 8 the limits of the deflection range are indicated in broken lines. The light beam 87 deflected by the deflection device 90 is passed to an optical head 96. The optical head 96 comprises a mirror 97 and an objective 98 for focusing the light beam onto the light-sensitive layer 85. The optical head 96 is movable in a radial direction relative to the rotating carrier 84 by means of an actuating device 99.

By means of the optical system described herein the light beam 87 is focused to form a scanning spot 100 on the light-sensitive layer 85, the position of said scaning spot 100 being dependent on the magnitude of the deflection of the light beam 87 produced by the deflection device 90 and the radial position of the write head 96 relative to the carrier 84. In the shown position of the optical head 96 the scanning spot 100 can be moved within a range B1 by means of the deflection device 90. By moving the optical head 96 the target point can be moved within a range B2 by means of the deflection device shown.

A control device 101, for example a computer system, enables the speed of the drive means 83 and the radial velocity of the actuating device 99 to be controlled in a customary manner, in such a way that the light-sensitive layer 85 is scanned by the radiation beam 87 with a constant scanning velocity in accordance with a spiral path. Such controlling system is described in detail in the Dutch patent application nr. 8701448. The control circuit 101 further generates the position-information signal Vp. The position-information signal Vp comprises a signal (see Fig. 9) which is in synchronism with a clock signal, i.e. the spacing between the zero crossing of the position-information are equal to a predetermined time interval T/2 or a multiple thereof.

The waveform of the position-information signal Vp is selected in such a way that the frequency spectrum of the position-information signal does not exhibit any strong frequency components situated within the frequency range intended for recording the information signal Vi.

The position-information signal Vp represents the position information, which comprises for example a time code as shown in Figure 2, which continually indicates the time which has expired since scanning has started.

The position-information signal Vp shown in Figure 9 exhibits a "biphase" modulation. Here the position-information code (PIC) is converted into a synchronous signal which is positive for the time interval T/2 and negative for the next time interval T/2 for a logic "1" of the position -information code (PIC). A logic "0" yields exactly the opposite binary signal, i.e. negative for the time interval T/2 and positive for the next time interval T/2.

As already stated, a "biphase" modulated signal has the advantage that it does not exhibit any strong frequency components in the low-frequency range, so that the position-information signal Vp may be utilized for velocity control of the record carrier 1. The position-information signal Vp is used to control the deflection device 90, so that the scanning point 100 will perform a radial undulation relative to the path defined by the position of the optical head 96, the instantaneous radial excursion corresponding to the instantaneous signal value of the position-information signal Vp.

After the light-sensitive layer 85 has been scanned in the manner described above it is subjected to an etching process, the parts of the layer 85 which have been exposed to the radiation beam 87 being removed, yielding a master disc formed with a groove which exhibits a radial undulation corresponding to the position-information signal Vp. Subsequently, replicas are made of this master disc and are provided with the recording layer 6. The record carrier thus obtained has a track in the

form of a groove. When the information signal Vi is recorded the information in the groove is provided with a pattern of recording masks corresponding to the information signal Vi. However, in practice it has been found that a better signal-to-noise ratio is obtained if the information signal is recorded in a track formed by a ridge instead of a groove. Such a record carrier 110 is shown in Figures 10a and 10b. The tracks in the form of ridges 111 are shown only diagrammatically in Figure 10a and they are shown to a strongly enlarged scale in an area 112 in Figure 10b. Figure 11 is a sectional view taken on the line XI-XI within the area 112 of the record carrier 110, which comprises a substrate 113, a recording layer 114, and a transparent coating 115.

As in the record carrier 110 the diameter of the grooves 116 situated between the ridges 111 is not constant as a result of the radial undulation of the ridges 111, the method of manufacturing differs from the method of manufacturing record carriers having a track pattern comprising grooves of constant with, as described with reference to Figure 8.

A track pattern of ridges of constant width can be obtained by means of a method which bears much resemblance to the method described with reference to Figure 8. However, in this case the light-sensitive layer 114 must consist of a negative photoresist instead of a positive photoresist. During development of a later consisting of such a negative photoresist the non-exposed portions of the photoresist are removed instead of the exposed portions as in the case of the customary positive photoresist, after which a master disc with the desired track pattern of ridges is obtained, of which subsequently replicas can be made in the customary manner/

The record carrier with a track pattern of ridges of constant width can also be obtained starting from a substrate 84 with a light-sensitive layer 85 consisting of the customary positive photoresist, from which the exposed portions are removed during development. In that case the carrier 84 is provided with a track pattern of grooves of constant width which is the complement of the desired track pattern of constant-width ridges. The winding sense of such a complementary track pattern of grooves is opposed to that of the desired track pattern. This means that for obtaining the carrier with an opposite track pattern only the direction of rotation of the carrier 84 during scanning must be opposite to the direction of rotation desired during reading of the record carrier 110. The process of scanning the carrier 84 can be controlled in the same way as decribed with reference to Figure 8.

Claims

1. A system for recording and/or reading an information signal, which system comprises an optically readable record carrier (1) provided with a track (4) containing an information area in which he information signal (Vi) is recorded or can be recorded, in which track a position-information signal (Vp) which is synchronous with a clock signal is recorded by means of a track modulation corresponding to the position-information signal (Vp), and an apparatus (50) for recording and/or reading the information signal, which apparatus comprises an optical system (53) for scanning the information area with a radiation beam, an optical detector (57) for detecting the radiation beam reflected by the information area and for generating a detection signal (Vd) which is representative of the modulation of the radiation beam caused by the track modulation, a detection circuit (59) for extracting the position-information signal (Vp) from the detection signal (Vd) and a clock-regeneration circuit (61,62) for recovering the clock signal (cl), characterized in that the track modulation corresponding to the position-information signal is situated at the location of the information area as a continuous track modulation in such way that the frequency spectrum (31) of the position-information signal is situated substantially outside the frequency range occupied by the frequency spectrum (30) of the information signal, and such that the frequency of the clock signal of the position-information signal is substantially constant when the track is scanned with a constant linear velocity, the apparatus further comprises a control circuit (65,67) for controlling on the basis of the clock signal the scanning velocity at a value for which the frequency of the clock signal (cl) is equal to a reference frequency (Vr), the frequency spectrum (31) of the position-information signal being situated substantially outside the frequency band (Br) employed for velocity control.

2. A system as claimed in Claim 1, characterized in that for the purpose of extracting the position-information signal from the detection signal the detection circuit (59) comprises a filter (60) having a pass band which substantially corresponds to the frequency band occupied by the frequency spectrum (31) of the position-information signal.

3. A system as claimed in any one of the preceding Claims, characterized in that the position-information signal exhibits a biphase modula-

tion.

4. A system as claimed in Claim 1 or 2, characterized in that the position-information signal exhibits a biphase-mark modulation.

5. A system as claimed in any one of the preceding Claims, characterized in that the track modulation is formed by a track undulation, the track excursion corresponding to the signal value of the position-information signal.

6. An apparatus for recording and/or reading information on/from an optically readable record carrier (1) provided with a track (4) containing an information area in which the information signal (Vi) is recorded or can be recorded, in which track a position-information signal (Vp) which is synchronous with a clock signal has been recorded by means of a track modulation corresponding to the position-information signal (Vp), which apparatus comprises an optical system (53) for scanning the information area with a radiation beam, an optical detector (57) for detecting the radiation bean reflected by the information area and for generating a detection signal (Vd) which is representative of the modulation of the radiation beam caused by the track modulation, a detection circuit (59) for extracting the position-information signal (Vp) from the detection signal (Vd) and a clock-regenerator circuit (61, 62) for recovering the clock signal (cl), characterized in that the apparatus further comprises a control circuit (65, 67) for controlling on the basis of the clock signal the scanning velocity at a value for which the frequency of the clock signal (cl) is equal to a reference frequency (Vr).

7. An optically readable record carrier (1) provided with a track (4) containing an information area in which an information signal (Vi) having a predetermined frequency spectrum has been recorded or can be recorded, in which track a position-information signal (Vp) which is synchronous with a clock signal has been recorded by means of a track modulation corresponding to the position-information signal (Vp), characterized in that the track modulation corresponding to the position-information signal is situated at the location of the information area as a continuous track modulation in such way that the frequency spectrum (31) of the position-information signal is situated substantially outside the frequency range occupied by the frequency spectrum (30) of the information signal, and such that the frequency of the clock signal of the position-information signal is substantially constant when the track is scanned with a constant linear velocity, the frequency spectrum (31) of the position-information signal not exhibiting strong frequency components in the low frequency range.

8. A method of manufacturing a record carrier as claimed in Claim 7, a radiation-sensitive area being scanned by a radiation beam (87) in accordance with a path corresponding to the desired track pattern, the radiation beam (87) being modulated during scanning with a position-information signal which is in synchronism with a clock signal, the position-information signal indicating the instantaneous scanning position, characterized in that the radiation-sensitive area is scanned with a constant linear velocity, and in that the frequency spectrum (31) of the position-information signal is situated substantially outside the frequency range (Be) intended for recording the information signal and substantially outside the frequency band used for velocity control during recording of the information signal.

9. A method as claimed in Claim 8, characterized in that the position-information signal exhibits a biphase modulation.

10. A method as claimed in Claim 8, characterized in that the position-information signal exhibits a biphase-mark modulation.

11. A method as claimed in any one of the Claims 8, 9 or 10, characterized in that for the purpose of modulating the radiation beam the beam is deflected in a direction perpendicular to the scanning direction over a distance which corresponds to the signal strength of the position-information signal.

12. A device for carrying out a method as claimed in any one of the Claims 8, 9, 10 or 11, comprising an optical system (97,98) for scanning a radiation-sensitive surface with a radiation beam (87) in conformity with the desired track pattern, means (101) for generating a position-information signal which is in synchronism with a clock signal and which indicates the instantaneous scanning position, and means (90) for modulating the radiation beam in conformity with the position-information signal during scanning, characterized in that the device is provided with means for controlling the linear scanning velocity to a constant value, and in that the signal-generating means (101) are adapted to generate a position-information signal (Vp) having a frequency spec-

trum (31) which is situated substantially outside the frequency range (Be) intended for recording the information signal and outside the frequency band used for velocity control during the recording of the information signal.

13. An apparatus as claimed in Claim 12, characterized in that the signal-generating means (101) are adapted to generate a biphase-modulated position-information signal.

14. An apparatus as claimed in Claim 12, characterized in that the signal-generating means (101) are adapted to generate a biphase-mark modulated position-information signal.

15. An apparatus as claimed in any one of the Claims 12, 13, or 14, characterized in that the apparatus comprises a deflection device (90) for deflecting the scanning beam under control of the position-information signal in a direction perpendicular to the scanning direction over a distance corresponding to the strength of the position-information signal.

Patentansprüche

1. System zum Aufzeichnen und/oder Auslesen eines Informationssignals, welches System einen optisch lesbaren Aufzeichnungsträger (1) mit einer ein Informationsgebiet enthaltenden Spur (4) umfaßt, in dem das Informationssignal (Vi) aufgezeichnet wird oder aufgezeichnet werden kann, in welcher Spur ein zu einem Taktsignal synchrones Positionsinformationssignal (Vp) mit Hilfe einer dem Positionsinformationssignal (Vp) entsprechenden Spurmodulation aufgezeichnet ist, und ein Gerät (50) zum Aufzeichnen und/oder Auslesen des Informationssignals, wobei das Gerät ein optisches System (53) zum Abtasten des Informationsgebiets mit einem Strahlungsbündel, einen optischen Detektor (57) zur Detektion des von dem Informationsgebiet reflektierten Strahlungsbündels und zur Erzeugung eines für die von der Spurmodulation verursachte Modulation des Strahlungsbündels repräsentativen Detektionssignals (Vd) enthält sowie eine Detektionsschaltung (59) zur Extraktion des Positionsinformationssignals (Vp) aus dem Detektionssignal (Vd) und eine Taktregenerationsschaltung (61, 62) zur Rückgewinnung des Taktsignals (cl), dadurch gekennzeichnet, daß die dem Positionsinformationssignal entsprechende Spurmodulation am Ort des Informationsgebiets als kontinuierliche Spurmodulation liegt, in der Weise, daß das Frequenzspektrum (31) des Positionsinformationssignals im wesentlichen außerhalb des von dem Frequenzspektrum (30) des Informationssignals belegten Frequenzbereichs liegt, und so, daß die Frequenz des Taktsignals des Positionsinformationssignals beim Abtasten der Spur mit konstanter linearer Geschwindigkeit nahezu konstant ist, und das Gerät außerdem eine Regelschaltung (65, 67) umfaßt, zur Regelung der Abtastgeschwindigkeit auf Basis des Taktsignals bei einem Wert, für den die Frequenz des Taktsignals (cl) gleich einer Bezugsfrequenz (Vr) ist, wobei das Frequenzspektrum (31) des Positionsinformationssignals im wesentlichen außerhalb des zur Geschwindigkeitsregelung verwendeten Frequenzbandes (Br) liegt.

2. System nach Anspruch 1, dadurch gekennzeichnet, daß zur Extraktion des Positionsinformationssignals aus dem Detektionssignal die Detektionsschaltung (59) ein Filter (60) mit einem Durchlaßbereich umfaßt, der im wesentlichen dem von dem Frequenzspektrum (31) des Positionsinformationssignals belegten Frequenzband entspricht.

3. System nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das Positionsinformationssignal eine Biphase-Modulation aufweist.

4. System nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das Positionsinformationssignal eine Biphase-Mark-Modulation aufweist.

5. System nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß die Spurmodulation von einer Spurschlingerung gebildet wird, wobei die Spurauslenkung dem Signalwert des Positionsinformationssignals entspricht.

6. Gerät zum Aufzeichnen und/oder Auslesen von Information auf/aus einem optisch lesbaren Aufzeichnungsträger (1) mit einer ein Informationsgebiet enthaltenden Spur (4), in dem das Informationssignal (Vi) aufgezeichnet ist oder aufgezeichnet werden kann, in welcher Spur ein zu einem Taktsignal synchrones Positionsinformationssignal (Vp) mit Hilfe einer dem Positionsinformationssignal (Vp) entsprechenden Spurmodulation aufgezeichnet ist, wobei das Gerät ein optisches System (53) zum Abtasten des Informationsgebiets mit einem Strahlungsbündel, einen optischen Detektor (57) zur Detektion des von dem Informationsgebiet reflektierten Strahlungsbündels und zur Erzeugung eines für die von der Spurmodulation verursachte Modulation des Strahlungsbündels re-

präsentativen Detektionssignals (Vd) enthält sowie eine Detektionsschaltung (59) zur Extraktion des Positionsinformationssignals (Vp) aus dem Detektionssignal (Vd) und eine Taktregenerationsschaltung (61, 62) zur Rückgewinnung des Taktsignals (cl), dadurch gekennzeichnet, daß das Gerät außerdem eine Regelschaltung (65, 67) umfaßt, zur Regelung der Abtastgeschwindigkeit auf Basis des Taktsignals bei einem Wert, für den die Frequenz des Taktsignals (cl) gleich einer Bezugsfrequenz (Vr) ist.

7. Optisch lesbarer Aufzeichnungsträger (1) mit einer ein Informationsgebiet enthaltenden Spur (4), in dem ein Informationssignal (Vi) mit einem vorgegebenen Frequenzspektrum aufgezeichnet ist oder aufgezeichnet werden kann, in welcher Spur ein zu einem Taktsignal synchrones Positionsinformationssignal (Vp) mit Hilfe einer dem Positionsinformationssignal (Vp) entsprechenden Spurmodulation aufgezeichnet ist, dadurch gekennzeichnet, daß die dem Positionsinformationssignal entsprechende Spurmodulation am Ort des Informationsgebiets als kontinuierliche Spurmodulation liegt, in der Weise, daß das Frequenzspektrum (31) des Positionsinformationssignals im wesentlichen außerhalb des von dem Frequenzspektrum (30) des Informationssignals belegten Frequenzbereichs liegt, und so, daß die Frequenz des Taktsignals des Positionsinformationssignals beim Abtasten der Spur mit konstanter linearer Geschwindigkeit nahezu konstant ist, wobei das Frequenzspektrum (31) des Positionsinformationssignals keine starken Frequenzkomponenten in dem niedrigen Frequenzbereich aufweist.

8. Verfahren zur Herstellung eines Aufzeichnungsträgers nach Anspruch 7, wobei ein strahlungsempfindliches Gebiet von einem Strahlungsbündel (87) entsprechend einem dem gewünschten Spurmuster entsprechenden Weg abgetastet wird, wobei das Strahlungsbündel (87) während des Abtastens mit einem zu einem Taktsignal synchronen Positionsinformationssignal moduliert wird, wobei das Positionsinformationssignal die augenblickliche Abtastposition angibt, dadurch gekennzeichnet, daß das strahlungsempfindliche Gebiet mit konstanter linearer Geschwindigkeit abgetastet wird und daß das Frequenzspektrum (31) des Positionsinformationssignals im wesentlichen außerhalb des Frequenzbereichs (Be) zum Aufzeichnen des Informationssignals und im wesentlichen außerhalb des beim Aufzeichnen des Informationssignals zur Geschwindigkeitsregelung verwendeten Frequenzbandes liegt.

9. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß das Positionsinformationssignal eine Biphase-Modulation aufweist.

10. Verfahren nach Anspruch 8, dadurch gekennzeichnet, daß das Positionsinformationssignal eine Biphase-Mark-Modulation aufweist.

11. Verfahren nach einem der Ansprüche 8, 9 oder 10, dadurch gekennzeichnet, daß zur Modulation des Strahlungsbündels das Bündel in einer zur Abtastrichtung senkrechten Richtung um einen Abstand abgelenkt wird, der der Signalstärke des Positionsinformationssignals entspricht.

12. Einrichtung zur Ausführung eines Verfahrens nach einem der Ansprüche 8, 9, 10 oder 11, mit einem optischen System (97, 98) zum Abtasten einer strahlungsempfindlichen Fläche mit einem Strahlungsbündel (87), entsprechend dem gewünschten Spurmuster, mit Mitteln (101) zur Erzeugung eines zu einem Taktsignal synchronen Positionsinformationssignals, das die augenblickliche Abtastposition angibt, und Mitteln (90) zum Modulieren des Strahlungsbündels (87) während des Abtastens entsprechend dem Positionsinformationssignal, dadurch gekennzeichnet, daß die Einrichtung mit Mitteln zur Regelung der Abtastgeschwindigkeit auf einen konstanten Wert versehen ist und daß die signalerzeugenden Mittel (101) zur Erzeugung eines Positionsinformationssignals (Vp) ein Frequenzspektrum (31) haben, das im wesentlichen außerhalb des Frequenzbereichs (Be) zum Aufzeichnen des Informationssignals und außerhalb des beim Aufzeichnen des Informationssignals zur Geschwindigkeitsregelung verwendeten Frequenzbandes liegt.

13. Gerät nach Anspruch 12, dadurch gekennzeichnet, daß die signalerzeugenden Mittel (101) zur Erzeugung eines biphase-modulierten Positionsinformationssignals eingerichtet sind.

14. Gerät nach Anspruch 12, dadurch gekennzeichnet, daß die signalerzeugenden Mittel (101) zur Erzeugung eines biphase-mark-modulierten Positionsinformationssignals eingerichtet sind.

15. Gerät nach einem der Ansprüche 12, 13 oder 14, dadurch gekennzeichnet, daß das Gerät eine Ablenkeinrichtung (90) zum Ablenken des Abtaststrahlenbündels unter Steuerung des Po-

sitionsinformationssignals in einer zur Abtastrichtung senkrechten Richtung um einen der Signalstärke des Positionsinformationssignals entsprechenden Abstand umfaßt.

Revendications

1. Système d'enregistrement et/ou de lecture d'un signal d'information, comportant un support d'enregistrement à lecture optique (1) présentant une piste (4) qui contient une zone d'information dans laquelle est enregistré ou peut être enregistré le signal d'information (Vi), piste dans laquelle un signal d'information de position (Vp), synchrone avec un signal d'horloge, est enregistré au moyen d'une modulation de piste correspondant au signal d'information de position (Vp), et un appareil (50) d'enregistrement et/ou de lecture du signal d'information, comportant un système optique (53) pour explorer la zone d'information par un faisceau de rayonnement, un détecteur optique (57) pour détecter le faisceau de rayonnement réfléchi par la zone d'information et pour engendrer un signal de détection (Vd) représentatif de la modulation du faisceau de rayonnement causée par la modulation de piste, un circuit de détection pour extraire le signal d'information de position (Vp) du signal de détection (Vd) et un circuit de régénération d'horloge (61, 62) pour récupérer le signal d'horloge (cl), caractérisé en ce que la modulation de piste correspondant au signal d'information de position est située sous la forme d'une modulation de piste continue à l'endroit de la zone d'information, de telle manière que le spectre de fréquences (31) du signal d'information de position est situé sensiblement en dehors de la gamme de fréquences occupée par le spectre de fréquences (30) du signal d'information et que la fréquence du signal d'horloge du signal d'information de position est sensiblement constante lorsque la piste est explorée à une vitesse linéaire constante, l'appareil comportant en outre un circuit de réglage (65, 67) pour régler, sur la base du signal d'horloge, la vitesse d'exploration à une valeur pour laquelle la fréquence du signal d'horloge (Cl) est égale à une fréquence de référence (Vr), le spectre de fréquences (31) du signal d'information de position étant situé sensiblement en dehors de la bande de fréquences (Br) utilisée pour le réglage de la vitesse.

2. Système selon la revendication 1, caractérisé en ce que, pour l'extraction du signal d'information de position du signal de détection, le circuit de détection (59) comporte un filtre (60) ayant une bande passante qui correspond sensiblement à la bande de fréquences occupée par le spectre de fréquences (31) du signal d'information de position.

3. Système selon l'une quelconque des revendications précédentes, caractérisé en ce que le signal d'information de position présente une modulation biphasée.

4. Système selon la revendication 1 ou 2, caractérisé en ce que le signal d'information de position présente une modulation à marques biphasées.

5. Système selon l'une quelconque des revendications précédentes, caractérisé en ce que la modulation de piste est constituée par une ondulation de piste, l'excursion de piste correspondant à la valeur du signal d'information de position.

6. Appareil d'enregistrement et/ou de lecture d'information sur un support d'enregistrement à lecture optique (1) présentant une piste (4) contenant une zone d'information dans laquelle est enregistré ou peut être enregistré le signal d'information (Vi), piste dans laquelle, au moyen d'une modulation de piste correspondant au signal d'information de position (Vp), est enregistré un signal d'information de position (Vp) qui est en synchronisme avec un signal d'horloge, appareil comportant un système optique (53) pour explorer la zone d'information par un faisceau de rayonnement, un détecteur optique (57) pour détecter le faisceau de rayonnement réfléchi par la zone d'information et pour engendrer un signal de détection (Vd) représentatif de la modulation du faisceau de rayonnement causée par la modulation de piste, un circuit de détection (59) pour extraire le signal d'information de position (Vp) du signal de détection (Vd), et un circuit régénérateur d'horloge (61, 62) pour récupérer le signal d'horloge (cl), caractérisé en ce qu'il comporte en outre un circuit de réglage (65, 67) pour régler, sur la base du signal d'horloge, la vitesse d'exploration à une valeur pour laquelle la fréquence du signal d'horloge (cl) est égale à une fréquence de référence (Vr).

7. Support d'enregistrement à lecture optique (1) présentant une piste (4) comportant une zone d'information dans laquelle est enregistrée ou peut être enregistrée un signal d'information (Vi) ayant un spectre de fréquences prédéterminé, piste dans laquelle, au moyen d'une modulation de piste correspondant au signal

d'information de position (Vp), est enregistré un signal d'information de position (Vp) qui est en synchronisme avec un signal d'horloge, caractérisé en ce que la modulation de piste correspondant au signal d'information de position est située à l'endroit de la zone d'information sous la forme d'une modulation de piste continue, de telle manière que le spectre de fréquences (31) du signal d'information de position se situe sensiblement en dehors de la gamme de fréquences occupée par le spectre de fréquences (30) du signal d'information et que la fréquence du signal d'horloge du signal d'information de position est sensiblement constante lorsque la piste est explorée à une vitesse linéaire constante, le spectre de fréquences (31) du signal d'information de position ne présentant pas de fortes composantes de fréquence dans la gamme de basses fréquences.

8. Procédé de fabrication d'un support d'enregistrement selon la revendication 7, une zone sensible au rayonnement étant explorée par un faisceau de rayonnement (87) suivant un trajet correspondant à la configuration de pistes souhaitée, le faisceau de rayonnement (87) étant modulé, au cours de l'exploration, par un signal d'information de position qui est en synchronisme avec un signal d'horloge, le signal d'information de position indiquant la position d'exploration momentanée, caractérisé en ce que la zone sensible au rayonnement est explorée à une vitesse linéaire constante, et en ce que le spectre de fréquences (31) du signal d'information de position est situé sensiblement en dehors de la gamme de fréquences (Be) destinée à l'enregistrement du signal d'information ainsi que sensiblement en dehors de la bande de fréquences utilisée pour le réglage de la vitesse au cours de l'enregistrement du signal d'information.

9. Procédé selon la revendication 8, caractérisé en ce que le signal d'information de position présente une modulation biphasée.

10. Procédé selon la revendication 8, caractérisé en ce que le signal d'information de position présente une modulation à marques biphasées.

11. Procédé selon l'une quelconque des revendications 8, 9 et 10, caractérisé en ce que, pour moduler le faisceau de rayonnement, le faisceau est dévié dans une direction perpendiculaire à la direction d'exploration, sur une distance correspondant à l'intensité du signal d'information de position.

12. Dispositif de mise en oeuvre d'un procédé selon l'une quelconque des revendications 8, 9, 10 et 11, comportant un système optique (97, 98) pour explorer une surface sensible au rayonnement par un faisceau de rayonnement (87) en conformité avec la configuration de pistes souhaitée, des moyens (101) pour engendrer un signal d'information de position qui est en synchronisme avec un signal d'horloge et qui indique la position d'exploration momentanée, et des moyens (90) pour moduler, au cours de l'exploration, le faisceau de rayonnement en conformité avec le signal d'information de position, caractérisé en ce qu'il est muni de moyens pour régler la vitesse d'exploration linéaire à une valeur constante, et en ce que les moyens générateurs de signaux (101) sont agencés pour engendrer un signal d'information de position (Vp) ayant un spectre de fréquences (31) situé sensiblement en dehors de la gamme de fréquences (Be) destinée à l'enregistrement du signal d'information ainsi qu'en dehors de la bande de fréquences utilisée pour le réglage de la vitesse au cours de l'enregistrement du signal d'information.

13. Appareil selon la revendication 12, caractérisé en ce que les moyens générateurs de signaux (101) sont agencés pour engendrer un signal d'information de position à modulation biphasée.

14. Appareil selon la revendication 12, caractérisé en ce que les moyens générateurs de signaux (101) sont agencés pour engendrer un signal d'information de position à modulation à marques biphasées.

15. Appareil selon l'une quelconque des revendications 12, 13 et 14, caractérisé en ce qu'il comporte un dispositif de déviation (90) pour dévier le faisceau d'exploration sous la commande du signal d'information de position, dans une direction perpendiculaire à la direction d'exploration, sur une distance correspondant à l'intensité du signal d'information de position.

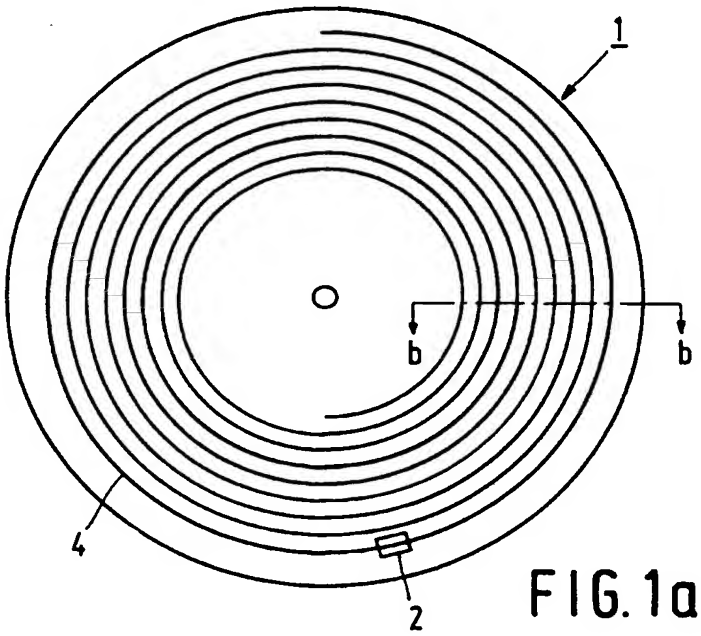

FIG.1a

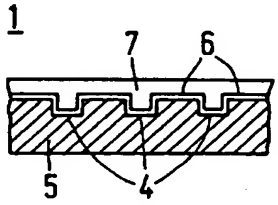

FIG.1b

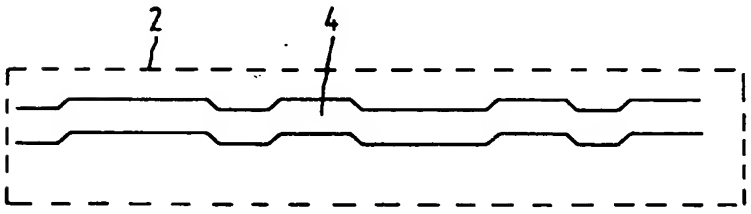

FIG.1c

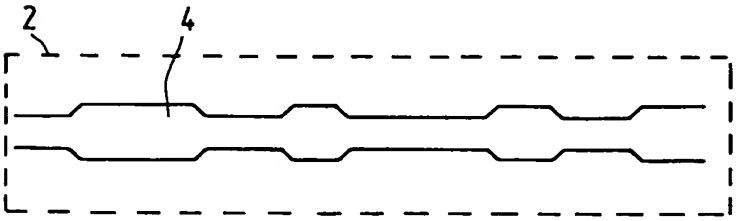

FIG.1d

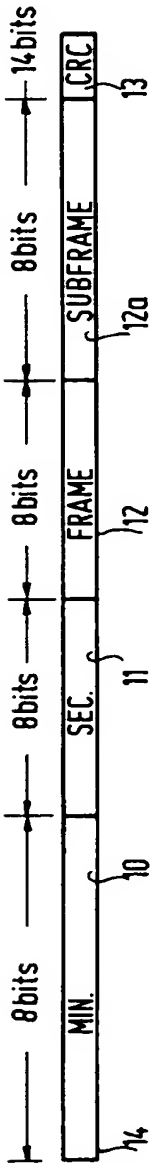

FIG.2

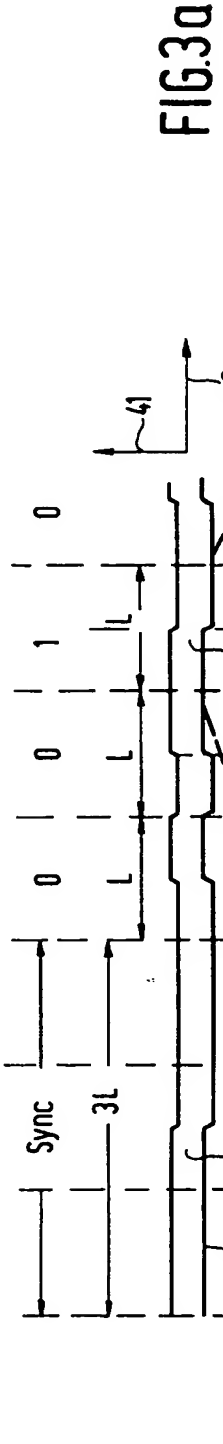

FIG.3a

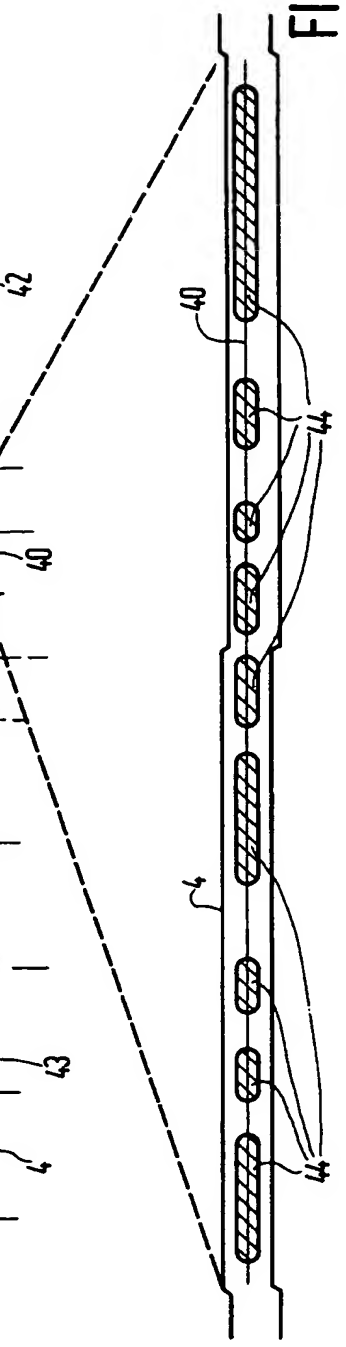

FIG.3b

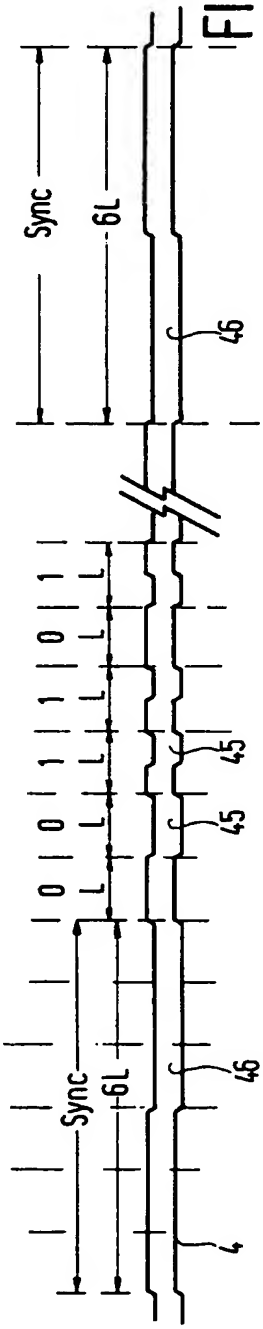

FIG.3c

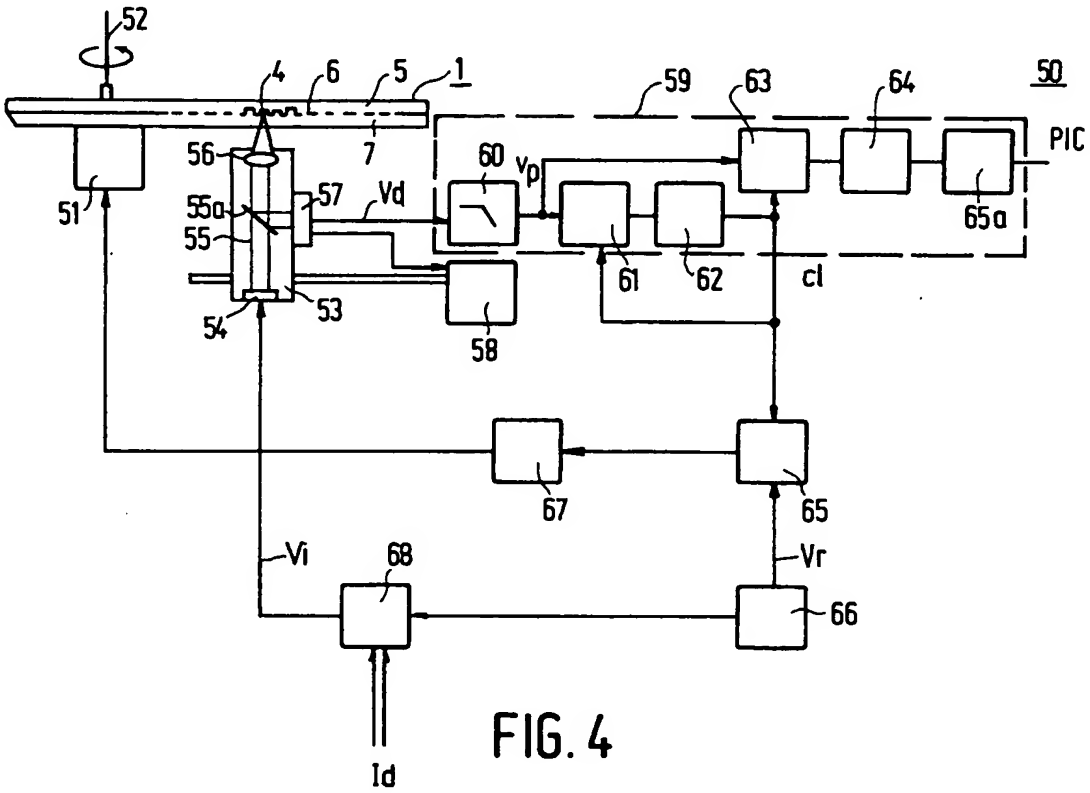
52
4
6
5
1
59
63
64
50
PIC
56
7
60
Vp
51
55a
57
Vd
55
61
62
Cl
65a
54
53
58
67
65
Vi
68
Vr
66
Id

FIG. 4

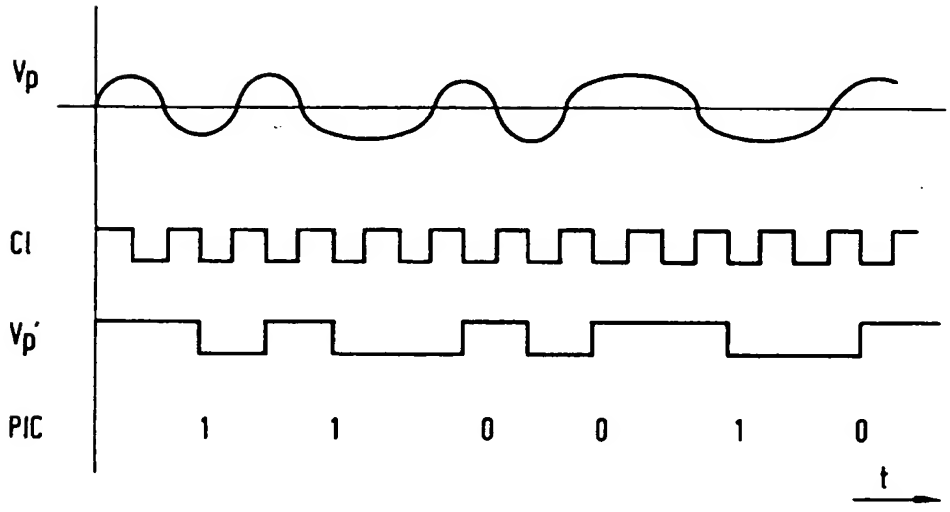
Vp
Cl
Vp'
PIC
1
1
0
0
1
0
t

FIG. 5

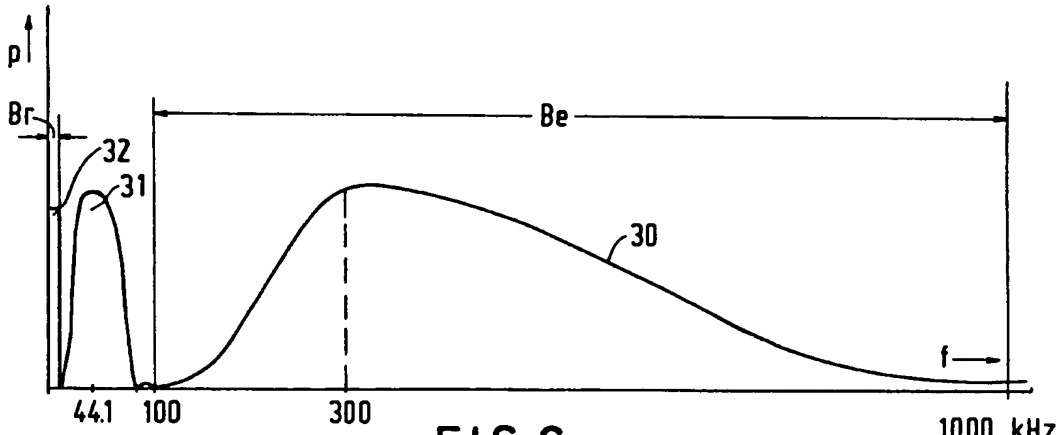

FIG.6

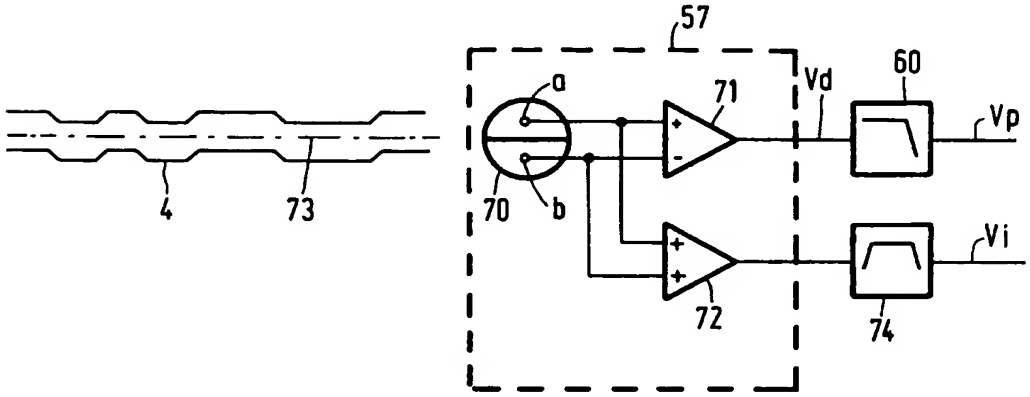

FIG.7

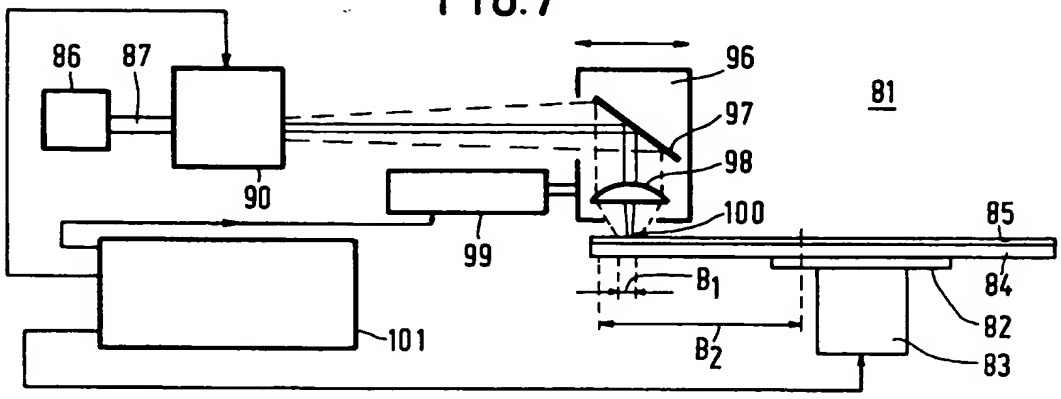

FIG.8

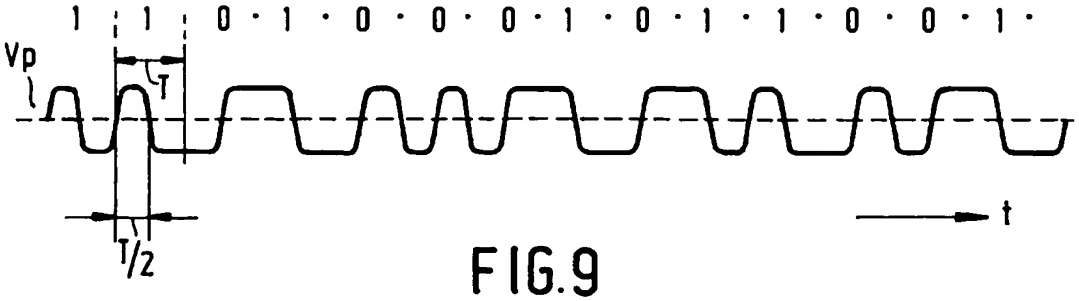

FIG.9

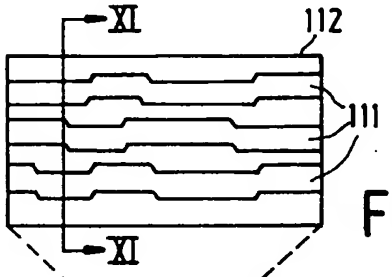

FIG.10b

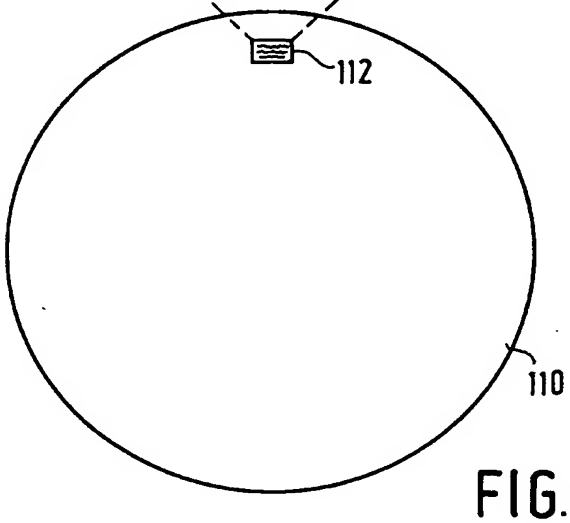

FIG.10a

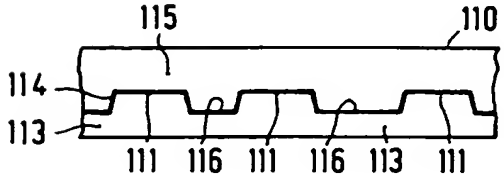

FIG.11